**WHAT IS PARTICULATE MATTER (PM)?**

Particulate air pollution is [defined by the US EPA](http://www.epa.gov/airscience/air-particulatematter.htm) as an air-suspended mixture of both solid and liquid particles. They are often separated into three classifications; coarse, fine and ultrafine particles. Coarse particles have a diameter of between 10µm and 2.5µm and settle relatively quickly whereas fine (0.1 to 2.5µm in diameter) and ultrafine (<0.1µm in diameter) particles remain in suspension for longer. To put things into perspective, human hair has a diameter of 50-70µm and a grain of sand has a diameter of 90µm.

When someone talks about PM10 they are referring to particles smaller than 10µm. These particles include dust, pollen and mold spores. Conversely, when someone references PM2.5 they are referring to particles smaller than 2.5µm. These smaller particles include combustion particles, organic compounds and metals.

**WHERE DOES IT COME FROM?**

Particulate matter can come from both human and natural sources. Natural sources include sea salt, forest fires, pollen and mold. As they are natural occurrences they are harder to control and are usually left unregulated. Human sources, however, can be regulated and understanding where PM comes from is very important. PM10 is most commonly associated with road dust and construction activities. Wear and tear of brakes and tyres on vehicles and crushing activities at construction sites can all contribute to a rise in PM10. Alternatively, PM2.5 is more associated with fuel burning, industrial combustion processes and vehicle emissions.

**WHY SHOULD WE MEASURE AMBIENT PARTICULATE MATTER?**

The growing awareness of both PM10 and PM2.5 is largely associated with the potential damaging effects they can have on the human body. The World Health Organisation (WHO) believes particles are affecting more people worldwide than any other pollutant. Primary health effects include damage to the respiratory and cardiovascular systems. Due to the small size of PM10 and PM2.5 particles, they can penetrate the deepest parts of the lungs as well as access the gas exchange regions of the lung via diffusion.

As a result of the damaging health effects from PM10 and PM2.5 the WHO recommend the following exposure limits:

[](http://www.aeroqual.com/wp-content/uploads/PM.jpg)

These guidelines can be hard to follow and many authorities do not meet the limits above, for example, the United States and Europe have much higher PM10 exposure thresholds. Governments must weigh up the potential damage to population health with the cost of reducing particulate concentrations. A great first step to understanding the seriousness of the issue is to monitor PM.

It is worth also mentioning larger particles (above 10µm). These sized particles are not usually acknowledged in government health legislation as they can be filtered out in the nose and throat. Instead, they are known as a nuisance rather than a health risk. Total Suspended Particles (TSP) is the term used when referring to larger particles. TSP does not have a specified size limit and therefore covers the full range of particle sizes. It is common for TSP to be measured alongside PM10 and PM2.5, particularly at industrial sites where nuisance dust assessment and monitoring is becoming more frequent.

**WHO SHOULD BE MONITORING?**

Heavily urbanised areas where there are high traffic volumes coupled with high population densities are most at risk. It is estimated that the largest city in China, Shanghai, has approximately 6.3 million residents exposed to PM at levels that exceed WHO guidelines.

**WHAT INSTRUMENTS CAN BE USED TO MEASURE AIRBORNE PARTICLES?**

There are a wide range of instruments available that can measure particulate matter to varying degrees of accuracy. To simplify things they can be split up into 4 classifications:

**1. Certified Reference Instruments**

To be included in this classification the instrument needs to use the gravimetric method of particulate measurement. This is the most accurate method currently available for measuring particulate matter and is widely used by regulatory bodies. Instruments include high vol and partisol™ samplers. Despite the high level of accuracy there are disadvantages to this method when compared to other options. Gravimetric measurement it is not a real-time form of measurement, it can only provide an average data set e.g. a daily average. It is also a very manual process resulting in high operational costs.

**2. Certified Equivalent Instruments**

There are several different equivalent methods and they all allow data at higher temporal resolution meaning they can report hourly averages (as low as 15 mins in some cases) rather than daily averages. The operational cost of running these instruments is relatively low and they can run automatically for extended periods of time. Instruments include the TEOM from Thermo, BAM from MetOne and the EDM 180 from Grimm. Many of these types of instruments require additional shelter and are not easily integrated with additional sensors such as wind speed and direction.

**3. Certified Indicative Instruments**

These instruments have a significantly lower purchase and operational cost compared to reference and equivalence instruments. They can usually be installed outside without additional shelter and can report data at minute resolution. The Aeroqual Dust Sentry is a certified indicative instrument.

**4. Indicative Instruments**

Instruments in this category do not have any formal certification and include the Aeroqual Dust Profiler. They have similar benefits when compared to the certified indicative instruments but will only be able to be used in applications when no certification is required. The Dust Profiler can measure PM1, PM10, PM2.5 and TSP simultaneously and therefore is particularly useful for research groups who want a better understanding of PM.

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